Interventional Magnetic Resonance Imaging-Guided Cell Transplantation into the Brain with Radially Branched Deployment.

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Authors: Matthew T Silvestrini, Dali Yin, Alastair J Martin, Valerie G Coppes, Preeti Mann, Paul S Larson, Philip A Starr, Xianmin Zeng, Nalin Gupta, S Scott Panter, Tejal A Desai, Daniel A Lim

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Public Summary:
In this work, we developed a new neurosurgical device that enables the delivery of stem cell-derived therapeutics to multiple target locations in the human brain with real-time interventional magnetic resonance image (iMRI) guidance. This iMRI-guided device functions as an "add-on" to standard neurosurgical and imaging workflows but overcomes some of the technical limitations inherent to the use of straight cannulas and standard targeting methods. This platform technology could have a major impact on the clinical translation of a wide range of cell therapeutics for the treatment of many neurological diseases.

Scientific Abstract:
Intracerebral cell transplantation is being pursued as a treatment for many neurological diseases, and effective cell delivery is critical for clinical success. To facilitate intracerebral cell transplantation at the scale and complexity of the human brain, we developed a platform technology that enables Radially Branched Deployment (RBD) of cells to multiple target locations at variable radial distances and depths along the initial brain penetration tract with real-time interventional magnetic resonance image (iMRI) guidance. iMRI-guided RBD functioned as an "add-on" to standard neurosurgical and imaging workflows, and procedures were performed in a commonly available clinical MRI scanner. Multiple deposits of superparamagnetic iron oxide (SPIO) beads were safely delivered to the striatum of live swine, and distribution to the entire putamen was achieved via a single cannula insertion in human cadaveric heads. Human embryonic stem cell-derived dopaminergic (hDA) neurons were biocompatible with the iMRI-guided RBD platform and successfully delivered with iMRI-guidance into the swine striatum. Thus, iMRI-guided RBD overcomes some of the technical limitations inherent to the use of straight cannulas and standard stereotactic targeting. This platform technology could have a major impact on the clinical translation of a wide range of cell therapeutics for the treatment of many neurological diseases.Molecular Therapy (2014); doi:10.1038/mt.2014.155.